REMARKS

Claims 1, 3-17, 27 and 31-37 are pending in the present application. All of the claims have been rejected. Claim 1 has been amended to specify that the present invention is directed to a "Biodegradable, thermoplastic, phase separated multiblock copolymer." Support for this amendment is found in the specification at least at page 1, line 1.

Applicants have carefully considered the non-final Office Action mailed on February 26, 2010 and respond to the specific issues raised therein as follows:

Claim Rejections – 35 USC § 103

Claims 1, 3, 4, 9, 13, 14 and 31-37 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Application Publication No. US 2001/0009662 to Cohn et al. ("Cohn"). Cohn discloses polymeric compositions comprising the reaction product of a diol, diamine or dicarboxylic acid with a chain extender or coupling agent in about a 1:2 mole ratio. The resulting product is reacted with a monofunctional hydroxyl, amine or carboxylic acid containing compound to produce a pentamer. Cohn teaches the synthesis of multi-block copolymers having a controlled block distribution by using ACA blocks or a monofunctional block AB. This exclusively results in alternating block copolymers having uniform length.

The claims for the present invention require multiblock copolymers wherein the segments of the copolymer are linked by an aliphatic chain-extender and randomly distributed in the copolymer. The specification discloses at page 12, lines 5-11 that:

> The method to obtain a copolymer with a random distribution of a and b (and optionally c) is far more advantageous than when the segments are alternating in the copolymer such as in (ab)n with the ratio of prepolymers a and b being 1. The composition of the copolymer can then only be determined by adjusting the pre-polymer lengths. In general, the a and b segment lengths in (ab)n alternating copolymers are smaller than blocks in block-copolymers with structures ABA or AB.

Cohn teaches alternating multiblock copolymers

Cohn teaches alternating multiblock copolymers, instead of the random multiblock copolymers required by present claim 1. A random multiblock copolymer in accordance with the present invention is, for example, represented by ABBBBBABAAABBAAAA… *etc.* An alternating multiblock copolymer according to the disclosure in Cohn on the other hand is, for example, represented by ABABABA… for the chain extension of AB prepolymers, or by ACAACAACAACA… for the chain extension of ACA prepolymers.

Based on the information regarding the constituents of the multiblock copolymer disclosed in Cohn, one of ordinary skill in the art would conclude that only alternating multiblock copolymers can be obtained and that multiblock copolymers with a random distribution of the segments cannot be obtained. The basis for such a conclusion is found in the teachings of Cohn as set forth in detail below.

Cohn discloses that either ACA or AB is chain extended. There is no teaching or suggestion by Cohn that ACA and AB can be chain extended concurrently to form a random multiblock copolymer having ***both*** ACA and AB blocks. In fact, one of ordinary skill in the art

would find that Cohn teaches away from combining AB and ACA blocks in the same copolymer. Evidence for this can be found in the following sections:

- Paragraph [0092] in Cohn discloses that: "***a polymeric composition comprising AB diblocks*** ... ***or ACA triblocks***," thereby specifically referring to the AB diblock and ACA triblock prepolymers in the alternative.

- Paragraph [0095] of Cohn states that: "*the present polymers preferably are based on polyester/poly(oxyalkylene)* ***ACA triblocks or AB diblocks***," again specifically referring to the AB diblock and ACA triblock prepolymers in the alternative.

- Paragraph [0096] of Cohn discloses that: "in the case of diblocks, these are coupled with difunctional chain extenders, in much the same way that triblocks are chain extended with the same chain extenders," without referring to an option for having chain extension between diblocks and triblocks.

- Paragraph [0112] of Cohn teaches that: "the product which is formed from the reaction of the chain extender, coupling agent or crosslinking agent *with the* ***ACA triblock or AB diblock***," again specifically referring to the AB diblock and ACA triblock prepolymers in the alternative.

Chain extension of AB diblocks only or, alternatively of ACA triblocks only, automatically leads to multiblock copolymers with either alternating AB diblocks and chain extender $(AB—Q)_n$, or alternating ACA triblocks and chain extender $(ACA—Q)_n$, respectively.

In contrast to the AB diblocks or ACA triblocks taught by Cohn, the present invention requires two different blocks —A and B— that are distributed randomly over the polymer chain.

Furthermore, from the description of the ACA triblocks and the AB diblocks in Cohn, one of ordinary skill in the art would understand that A and C in ACA triblocks ***or*** A and B in AB diblocks are ***always covalently linked*** to each other prior to chain extension. This is clearly disclosed in the following teachings of Cohn:

- Paragraph [0125] of Cohn teaches that: "AB diblocks according to the present invention comprise a first polyester A block … ***covalently linked*** to a B block."

- Analogously, paragraph [0132] of Cohn teaches that: "polymers according to the present invention which comprise a first polyester A block ***covalently linked*** to a diol, diamine or dicarboxylic acid compound C block … which is, in turn, ***covalently linked*** to a second polyester A block."

- Paragraph [0141] states that: "The term 'crosslinked' or 'crosslinker' is used to describe agents which ***covalently bond*** the ***ACA triblocks or AB diblocks*** to other triblocks, diblocks or other moieties in the present polymers."

As a consequence of the covalent linking of the blocks, only the following alternating multiblock copolymers can be obtained by Cohn: $(ACA—Q)_n$ in the case of ACA triblocks and $(AB—Q)_n$ in the case of AB diblocks, wherein Q is the chain extender.

In contrast to the ACA triblocks and AB diblocks taught by Cohn, the different segments (selected from A and B) of the present invention are always chain extended with a chain extender to form a polymer with ***A and B distributed randomly*** over the polymer chain. Hence, there is always a chain extender between the different prepolymer segments A and B so that the segments are not linked together in a fixed order.

The use chemically distinct polyester A blocks is not Obvious

The Office Action states that the claimed multiblock copolymers would have been obvious to a person of ordinary skill in the art in view of the properties of block "A" of the ACA triblock copolymer. The Office Action states on page 5 that:

> [I]t follows that the ordinary skilled artisan would have been highly motivated to use routine experimentation to polymerize chemically distinct polyester "A" blocks and link them aliphatically, in order to produce the instantly claimed multiblock copolymer chain.

The Applicants respectfully disagree. Cohn neither teaches nor suggests using different types of "chemically distinct polyester 'A' blocks" to prepare a single multiblock copolymer as the claims require. Instead, Cohn ***teaches away*** from such an embodiment. Both the description and the Examples in Cohn, specifically refer to multiblock copolymers wherein only one type of "A" block is used for the AB diblock or the ACA triblock. Also in Examples 8 and 10, referred to by the Examiner, only a single type of A block is used. Moreover, these Examples utilize a macro chain extender prepared by reaction of polycaprolactone and hexamethylene diisocyanate for chain extension of a diblock. Similar to small chain extenders, the macro chain extender can only lead to alternating multiblock copolymers.

Monomeric/polymeric nature of A and B blocks

At page 8, the Office Action refutes the Applicants' arguments that Cohn fails to teach or suggest random polymer structures as required by the claims by stating that:

> It is understood that Applicants' invention is directed to a random, multiblock copolymer. However, contrary to Applicants' assertions, the Cohn reference defines ***both the "A" and "B" blocks*** as being ***either monomeric or polymeric***, thereby minimally suggesting randomness to the very nature of the diblock. (Emphasis added.)

The Office Action concludes that the possibility for "A" and "B" blocks in the AB diblocks to be "either monomeric or polymeric minimally" suggests a randomness of the diblock. However, it is firstly noted that Cohn teaches that "A" blocks are "polymeric" but does not teach or suggest that "A" blocks are "monomeric." This follows from paragraph [0012] of Cohn, which discloses that "A is a polyester unit derived from the polymerization of monomers." Cohn teaches that the "A" block is a polymer that is "derived from the polymerization of monomers," but does not teach that the "A" blocks can be formed by "unpolymerized" monomers. Paragraph [0017] of Cohn states that: "Z is derived from an amine- or hydroxyl-containing monoflnctional [sic] monomeric or polymeric compound." One of ordinary skill in the art would understand that this means that Z was formed by polymerizing a monomeric or polymeric compound into a polymer.

Paragraph [0012] of Cohn further discloses that "B may be derived from any monofunctional hydroxyl, amine or carboxyl containing molecule which is capable of initiating

polymerization of the monomers which comprise the A block." Accordingly, Cohn teaches that "A" must be polymeric and only "B" can be either monomeric or polymeric.

The Office Action found that "the Cohn reference defines both the "A" and "B" blocks as being either monomeric or polymeric, thereby minimally suggesting randomness to the very nature of the diblock." As set forth above, this is not correct and Cohn clearly teaches that the "A" blocks can ***only*** be polymeric. Therefore, applying the same logic used in the Office Action, if the Cohn reference defines the "A" block as being ***only*** polymeric, then this ***minimally suggests*** the very nature of the diblock disclosed in Cohn is ***not*** random.

Moreover, the possibility of the "B" blocks being either monomeric or polymeric does not ***minimally suggest*** a random multiblock copolymer, since there is absolutely no teaching or suggestion in Cohn to use different types of "B" blocks within the same multiblock copolymer. Both the description and the Examples in Cohn only refer to multiblock copolymers wherein only a single type of "B" block is used for the AB diblock.

Cross-linking

The Office Action states at page 7 that:

> Cohn expressly teaches in ¶[0012] that the multiblocks may be polymerized through coupling or crosslinking of the diblocks. It is further taught and suggested in the discussion of "crosslinking" at ¶[0141], that the already randomly defined di- and tri-block copolymers may be bound to other diblocks, triblocks and other moieties of the invention.

Paragraph [0141] of Cohn discloses polymers wherein diblocks and triblocks may be bound to other diblocks, triblocks and other moieties by a crosslinker. However, this does not lead to non-crosslinked multiblock copolymers, or in the alternative to linear multiblock copolymers as defined in the present claims. Paragraph [0141] of Cohn clearly states "as used herein, a crosslinker refers to a chemical compound which contains at least three (3) reactive moieties." Reaction of AB diblocks, or alternatively ACA triblocks, with such a crosslinker that has at least three reactive moieties will result in a ***thermosetting polymer*** with a 3-D network of bonds rather than a ***thermoplastic*** one as required by amended claim 1. Accordingly, the amendment to claim 1, which requires the copolymer to be a "thermoplastic," distinguishes the claims from the crosslinked copolymers taught by Cohn.

Combined use of AB and BA diblocks

The Office Action states at the bottom of page 7 that:

> Lastly, concerning Applicants' assertion pertaining to the order of the copolymer blocks, the Examiner maintains that an "A" block is not always or necessarily followed by either a "B" or "C" block, as evidenced by the foregoing discussion. It is possible, that an "AB" block may be followed by a "BA" block or an "ACA" block.

The Applicants respectfully submit that, in accordance with the teaching of Cohn, an AB diblock may be followed by a BA diblock. However, there is no teaching or suggestion in Cohn that an AB diblock can be followed by an ACA triblock. Cohn consistently teaches that the AB blocks and the ACA blocks are different embodiments. As already shown above, there is no

disclosure or suggestion by Cohn that ACA and AB can be chain extended concurrently to a random multiblock copolymer having ACA and AB blocks.

When the AB diblock is difunctional with the same functional group, the following multiblock copolymers may be generated by chain extension with a difunctional chain extender, Q:

—AB—Q—BA—Q—BA—Q—BA—Q—AB—Q—AB—Q—BA—Q—

That is, AB may be followed by either BA or AB. However, this multiblock copolymer will have similar chemical properties as an alternating multiblock copolymer and in fact is not phase separated, as required by amended claim 1.

As explained, in the Applicants' international publication at page 2, lines 23-29:

> The term "phase-separated", as used herein, refers to a system, in particular a copolymer, built of two or more different prepolymers, of which at least two are incompatible with each other at temperatures of 40° C. or below (when kept at body conditions). Thus the prepolymers do not form a homogeneous mixture when combined, neither when combined as a physical mixture of the prepolymers, nor when the prepolymers are combined in a single chemical species as "chemical mixture", viz. as copolymer.

The above polymer disclosed by Cohn is not built of two or more ***different prepolymers*** because the prepolymer AB is clearly identical to the prepolymer BA. Moreover, in the above described multiblock copolymer, it is not possible to have large distinct A and B domains, illustrating that this is not a phase-separated multiblock copolymer.

New Claim Rejections – 35 USC § 103

Claims 5-8, 10-12, 15-17 and 27 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Cohn in combination with U.S. Patent No. 5,066,772 to Tang et al. ("Tang"), which discloses copolymers of recurring units.

The teachings of Cohn and how they are distinguishable from the claims of the present invention have been discussed above in detail. With regard to Tang, the Office Action states on page 9 that:

> Tang et al. [] expressly defines random copolymer fabrication in terms of both the "A" and "B" block (col. 7, line 59 to col. 8 line 33). Of particular note is that the components of each block may comprise a single type of recurring monomeric unit or, alternatively, each may comprise multiple type of recurring monomeric unit, ***randomly distributed throughout each block*** (col. 8, lines 10-15).
>
> (Emphasis added.)

The specific teaching in Tang cited in the Office Action is found at col. 8, lines 4 to 13 and states that:

> As used herein, the term "block" means a sequence of one type of monomeric unit at least about 5 monomeric units long, or such sequence of two or more types of ***recurring monomeric units either randomly distributed in such a sequence*** or distributed such sequence in a block-like fashion. Each "A" block and "B" block may comprise a single type of recurring monomeric unit. Alternatively, each block may comprise more than one type of recurring monomeric unit, ***randomly distributed throughout each block***.
>
> (Emphasis added.)

The last line of amended claim 1 requires "prepolymer (A) and the segments of the hard biodegradable prepolymer (B) [to be] ***randomly distributed in the copolymer***." (Emphasis

added.) The ***random distribution*** taught by Tang is ***not in the copolymer*** but in the blocks that are used to form the copolymer. The definition of the term "block" as it is defined above in Tang states that the block can be made up of: "***recurring monomeric units . . . randomly distributed.***" The Office Action confirms this when it states (as cited above) that the monomeric units are "***randomly distributed throughout each block.***" One of ordinary skill in the art would not find the ***random distribution of blocks in a copolymer*** required by the present claims obvious in view of the ***random distribution of monomeric units in a block taught by Tang***.

Tang describes copolymers for use in the fabrication of a medical device. As clearly indicated by Tang, these copolymers are either random copolymers, or in the alternative block copolymers (col. 7, lines 59-62). Tang does not describe random multiblock copolymers as provided by the present invention. The block copolymers disclosed in Tang have repeating block units (col. 8, lines 14-20). The nature of randomness as required by the present invention implies that the copolymer does not possess a repeating block unit as described in Tang. Since the block copolymers mentioned in Tang possess reoccurring repeating blocks they are in fact ordered block copolymers, rather than random block copolymers. The random copolymers in Tang, on the other hand, have a complete random sequence of monomeric units, and lack defined blocks. Therefore, Tang only teaches random copolymers, rather than random block copolymers (e.g., col. 7, line 60; col. 8, line 37; col. 9, lines 4-5, 7-8 and 14; and col. 13, Example 4). Moreover, in the present invention the fabrication of a phase separated multiblock copolymer with random distribution of the segments is enabled by the use of a multifunctional chain extender, which is absent in the copolymers taught by Tang.

Distinguishing characteristics of the random multiblock copolymers in the Claims

The random multiblock copolymers of the present invention provide many advantages that cannot be obtained with alternating multiblock copolymers.

First, the random multiblock copolymers obtained by chain extension of A and B blocks have unlimited A to B ratio. A:B can, for instance, be 10:90, but may as well be 90:10. In contrast, the ratio of the blocks in an alternating multiblock copolymer is limited to the ratio used in the chain extended polymer. For instance, in the case of chain extension of AB the A:B ratio in the multiblock copolymer is 50:50. The random nature of the multiblock copolymers of the present invention greatly increases the possible compositions of the material and thereby the control over its physical and chemical properties. This includes more control over the swelling capacity in water, morphology (phase separation, amorphous/crystallinity) and polymer degradation.

Second, the synthesis method of the random multiblock copolymers of the present invention is much less laborious as compared to the synthesis of alternating multiblock copolymers. In alternating multiblock copolymers, either segment A and B in case of AB diblocks (or either segment A and C in case of ACA triblocks) have to be linked prior to chain extension (or a macro chain extender needs to be synthesized). In accordance with the present invention, separate A and B blocks are chain extended with, e.g., a commercially available chain extender.

Conclusion

Applicants submit that the amendment to claim 1 and the arguments made herein clearly distinguish the cited prior art and respectfully request allowance of the claims.

If the Examiner has any questions relating to this Amendment, the Examiner is respectfully invited to contact Applicants' attorney at the telephone number provided below.

Respectfully submitted,

/kevin e. mcdermott/
Kevin E. McDermott
Registration No: 35,946
Attorney for Applicants

HOFFMANN & BARON, LLP
6900 Jericho Turnpike
Syosset, New York 11791
(516) 822-3550

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